Partnership to Increase Energy Efficiency and Renewable Energy in Intermountain Field Area National Parks

National Park Service
and
Department of Energy

1995

The Challenge

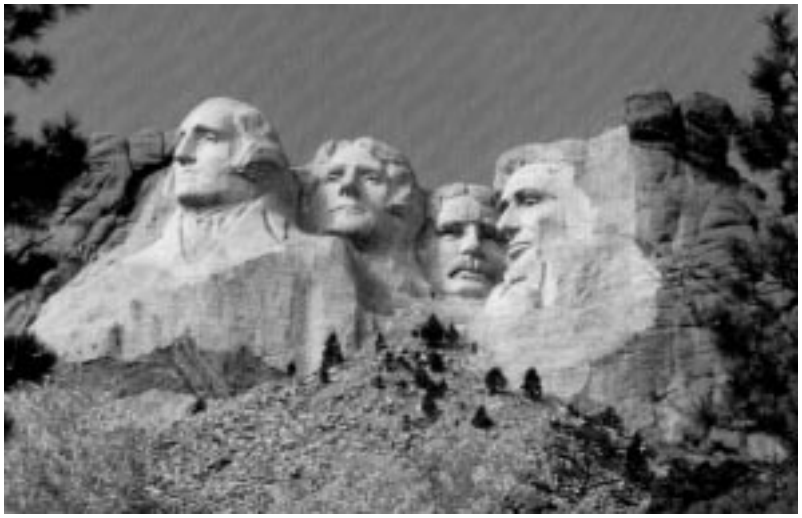
The Energy Policy Act of 1992 (EPAct), requires Federal agencies to reduce energy consumption of their facilities, meet fleet requirements for alternative fuel vehicles, and install energy and water conservation measures with a 10 year payback by 2005.

Executive Order 12902 was designed to meet and exceed the energy efficiency and water conservation provisions contained in EPAct and increase investments in solar and other renewable energy. Key provisions of Executive Order 12902 requires Federal Agencies to:

- Reduce energy consumption in Federal facilities 30% by the year 2005 over 1985 levels.
- Reduce the use of petroleum in Federal facilities.
- Adopt design practices that meet Federal energy performance standards.
- Establish a priority list of facilities for energy audits.
- Implement all cost-effective energy efficiency measures and renewable energy technologies identified in the energy audits.
- Utilize innovative financing and contractual mechanisms to meet the requirements of EPAct and Executive Order 12902.

A number of resources are available to National Park Service Managers through the Department of Energy (DOE) and state energy offices in Region VIII to assist them in meeting these challenges. They are described in the following pages.

The Opportunity



Partnership between the Weatherization Managers Association and NPS involves the implementation of cost-effective weatherization techniques at Grand Tetons, Rocky Mountain N.P. and Mt. Rushmore.

The National Park Service (NPS) pays some of the highest energy costs among agencies in the Federal government. Some park facilities pay over 50¢ per KWH to generate electricity at remote sites.

In 1994, a survey conducted by the NPS Denver Service Center indicated the NPS Rocky Mountain Region spent over $1.4 million on electric energy — not including diesel fuel for diesel-fired generators, and natural gas and propane for space heating.

A follow up survey identified a list of over $2.4 million of energy efficiency improvements and renewable energy projects national parks, recreation areas and monuments were interested in undertaking.

Dollars saved through investments in energy efficiency and renewable energy projects can be reprogrammed to other pressing park needs such as capital improvements, restoration, interpretation, and personnel.

In addition, energy conservation programs can serve as a valuable education tool to the millions of visitors that come to the region's parks. Programs also support overall mission of NPS managers to conserve natural resources and cultural values in our nation's parks, recreation areas and monuments.

Energy Partnerships

Budget priorities, a shortage of funding and lack of widespread technical energy expertise within the National Park Service have kept the parks, recreation areas and monuments of the Intermountain Field Area from aggressively undertaking energy efficiency and renewable energy projects.

Partnerships with outside organizations offer the NPS the opportunity to leverage limited technical expertise, financial resources, and equipment to develop innovative, cost-effective, and environmentally benign solutions to the energy problems faced by the parks and other NPS facilities.

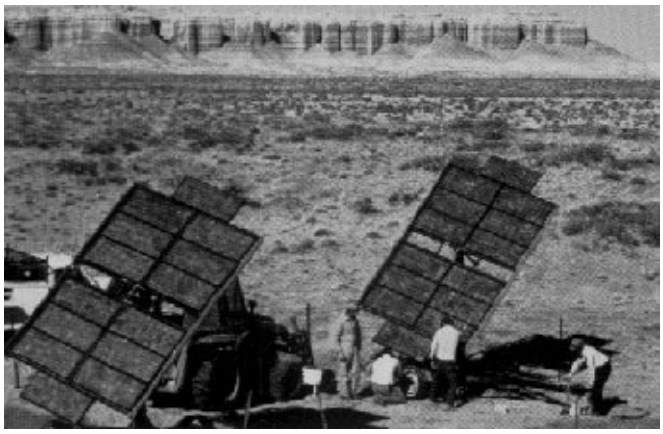
Recognizing the vast potential for cost-effective renewable energy and energy efficiency projects which could be showcased at National Park facilities, the DOE Denver Regional Support Office (DRSO) and the former Rocky Mountain Region of NPS drafted an interagency agreement formalizing a collaborative effort. The resulting partnership aims to facilitate coordination among NPS and State Energy Offices, Weatherization Offices, DOE Labs, FEMP and other DOE programs.

Goals of the Partnership:

- Leverage technical energy expertise and financial resources of the NPS, DOE, and state energy offices in Region VIII to assist the NPS in meeting goals of Executive Order 12902.
- Demonstrate how energy efficient design, energy conservation practices, and use of renewable energy systems can enhance the mission of the National Park Service.
- Create “market pull” for under-utilized and emerging energy efficient and renewable energy technologies and practices.
- Educate millions of visitors to the region’s national parks, recreation areas and monuments on the economic feasibility and environmental benefits of energy conservation measures.

The NPS has already participated in a number of partnerships, some of which are highlighted in this handout. (See the Appendix for additional projects)

DRSO and State Services



The Utah Energy Office developed portable PV water pumping systems to help preserve riparian areas both on public and private lands

Several states and the DOE Denver Regional Support Office can help NPS facilities develop projects in energy efficiency and renewable energy through a variety of services. Energy services include:

- Brokering partnerships between utilities, park concessionaires, state government and the U.S. DOE to finance and deliver cost-effective energy services to the NPS.
- Technical assistance and energy engineering services including:
    - Energy efficient design guidelines and building design assistance.
    - Feasibility analysis and field evaluation of energy efficiency opportunities and renewable energy systems.
    - Monitoring and performance evaluations of installed energy technologies and renewable energy systems.
    - Current information on cost and performance of energy efficiency and renewable energy technologies.
- Conducting economic analysis of alternative energy systems.
- Coordinating energy efficiency, renewable energy technology and alternative financing workshops for NPS contracting, facility and maintenance personnel.

Contact: Ken Snyder at the DOE Denver Regional Support Office for more information on energy services that state energy offices and the Regional Support Office can provide, (303)231-5750 x161.

Partners in Profile

Montana DNR - The Montana Department of Natural Resources and Conservation - Energy Division has been working with Yellowstone National Park on investigating remote applications of photovoltaics. A complicated electric rate system at Yellowstone incorporates fixed operation and maintenance costs, reducing the incentive to pursue energy conservation measures. MT DNR has been working with MT Power to isolate fixed and variable costs to more accurately measure cost effective conservation projects. MT DNR has also helped Yellowstone obtain a rapeseed based biofuel powered truck for tourism-related transportation. For more information contact Tom Livers, MT DNR (406)444-6699.

Colorado OEC - The Colorado Office of Energy Conservation has developed a mutually beneficial relationship with the Colorado State Division of Parks. OEC's energy program has successfully demonstrated the use of PV and solar thermal systems in a variety of applications within the park system. Contact Marc Roper, (303)620-4292, at OEC for information on low cost renewable energy applications in parks and lessons learned thus far with this project.

Utah DNR - The Utah Department of Natural Resources is active in several projects with NPS and Utah State Parks. See pages 12, 16 and 17 for project partnership examples. The Utah DNR provides services including energy audits, energy efficiency design assistance, energy engineering feasibility and economic analysis, and installation of renewable energy systems. For more information, contact Jeff Burks, Utah DNR, (801)538-5428.

DOE DRSO- The Department of Energy Denver Regional Support Office provides technical assistance for energy audits, energy engineering feasibility analysis, and economic analysis reports. DRSO works with DOE labs and DOE Headquarters on SAVEnergy Audits, the Federal Energy Management Program and the Federal Energy Efficiency Fund to help pursue energy conservation programs with NPS (See pages 6-7). In essence, DRSO plays a facilitator role in linking NPS to the appropriate technical and financial resources available at both the State and Federal level. For more information on the NPS-DOE Region VIII partnership, call Ken Snyder at DRSO, (303)231-5750 x161.

DOE Labs and Weatherization Offices - See pages 8 through 10 for information on services available from Sandia National Labs and the National Renewable Energy Laboratory and page 11 for information on Weatherization Manager's Association Partnership program with NPS in Region VIII.

Other Organizations - Other organizations which can provide resources and services to assist the NPS in meeting energy efficiency goals include: investor-owned and municipal utilities, the Environmental Protection Agency and energy service companies.

FEMP and FEEF

The Federal Energy Management Program

FEMP helps Federal energy managers identify and procure the best energy-saving projects. It does this through proactive problem solving; an aggressive emphasis on increasing the number and quality of projects; and effective partnerships among agencies, utilities, the private sector, and states.

FEMP can help agencies meet the 30% energy reduction mandate by 2005 with a program resources including:

- Technical assistance/software tools
- SAVEnergy audit program
- Federal Energy Efficiency Fund
- Energy savings performance contracting
- State and Utility partnerships, and
- Training

The benefits of FEMP accomplishments are considerable. FEMP's efforts have already helped reduce Federal energy costs by more than half a billion dollars over the last 2 years.

FEMP's Federal Energy Efficiency Fund

The Fund was established by the Energy Policy Act of 1992 to improve energy efficiency in Federal facilities. The Fund provides grants to other Federal agencies to implement energy efficiency and water conservation projects. The grants enhance and leverage other funding sources. In fiscal year FY 1994, $6 million was available to agencies. In FY 1995, agencies will receive grants worth $8 million. Funding awards are based on the following evaluation criteria:

- Cost effectiveness
- Energy savings
- Agency cost sharing
- Non-federal financing

See page 14 for a description of a FEEF project currently under way at Yellowstone National Park.

SAVEnergy Program and Performance Based Contracts

The SAVEnergy Program

The SAVEnergy Program has three key elements:

- *The Action Plan* with recommended conservation actions. The Action Plan starts with an energy and water conservation audit of the facility conducted by pre-qualified A/E firms. In addition to collecting data on energy and water use, the auditors develop and evaluate conservation alternatives, using a fuel-neutral approach.
- *The Action Team* to implement the SAVEnergy Action Plan. The Action Team works to overcome barriers to completing projects, facilitates energy savings performance contracts, and evaluates agency eligibility for financing projects through the Federal Energy Efficiency Fund.
- *A project-tracking data base* to evaluate the SAVEnergy Program and record progress toward conservation goals.

For more information of FEMP, FEEF and the SAVEnergy Program, contact Randy Jones, (303)231-5750 x135, at the DOE Denver Regional Support Office.

Energy Savings Performance Based Contracting

Energy Savings Performance Contracting (ESPC) is an alternative to the traditional method of financing energy efficiency improvements in federal facilities. Under this alternative financing arrangement, federal agencies contract with energy service companies who pay all the up-front costs; and similar to ESPC used in relighting DOE's headquarters building, the contractor is paid entirely through energy savings generated by the project. At the end of the contract period, which can be up to 25 years, the federal government retains all the savings and equipment.

DOE's Federal Energy Management Program (FEMP), for example, is joining the National Park Service in a project to make the Statue of Liberty and Ellis Island national monuments energy efficient. Installation of energy-efficient lighting and a host of other energy efficient measures will greatly reduce operating expenses.

Agencies can use future energy savings to fund projects, freeing up money currently wasted on energy inefficiency and making it available for facility improvements and sustained maintenance.

Contact: Andy Walker, 303-275-6048, of NREL for information on Performance Based contracting.

Sandia - NPS PV Assessment

In the Fall of 1993, the NPS Denver Service Center and the Photovoltaic Design Assistance Center at Sandia National Laboratories developed a partnership to assess photovoltaic opportunities in NPS facilities. The assessment focused on four major efforts:

- Locate existing photovoltaic systems,
- Assess satisfaction with existing photovoltaic systems,
- Identify potential future photovoltaic projects, and
- Identify barriers to use of photovoltaic power and propose solutions.

A total of 455 operational photovoltaic systems were identified. Many applications are less than 1 KW, while the largest system is 50 KW at Natural Bridges N.M.

Opportunities to use photovoltaic systems were identified by 125 field units and totaled 643 separate projects. Of these, 33 parks noted needs for small systems such as a lighting, and remote monitoring, and 87 parks identified photovoltaic opportunities for major projects such as facility power and campground development.

Phase II surveys were sent to parks that had identified potential large scale PV projects so that the size of PV systems and the cost programming such projects could be estimated. The goal is to formulate a five-year program, called “Renew the Parks,” to expand the use of renewable energy in NPS facilities.

A cost-effective application of PV power for remote communication

Contact: Hal Post at Sandia (505)844-2154 or Doug DeNio at the NPS Denver Service Center (303)969-2162 for more information.

Sandia's PV Design Assistance Center

Solar outdoor lighting for recreation trails

The Photovoltaic Design Assistance Center is a national resource for technical information about photovoltaic systems. The Center is part of Sandia National Laboratories in Albuquerque, NM. The Center provides, at no cost, evaluations and advice for assistance requests that fall within its mission.

Those needing information about photovoltaic technology may use the Center to decide whether photovoltaics can fill their needs.
The Center has made feasibility analyses and field evaluations of systems that range in size from a few watts to several megawatts.

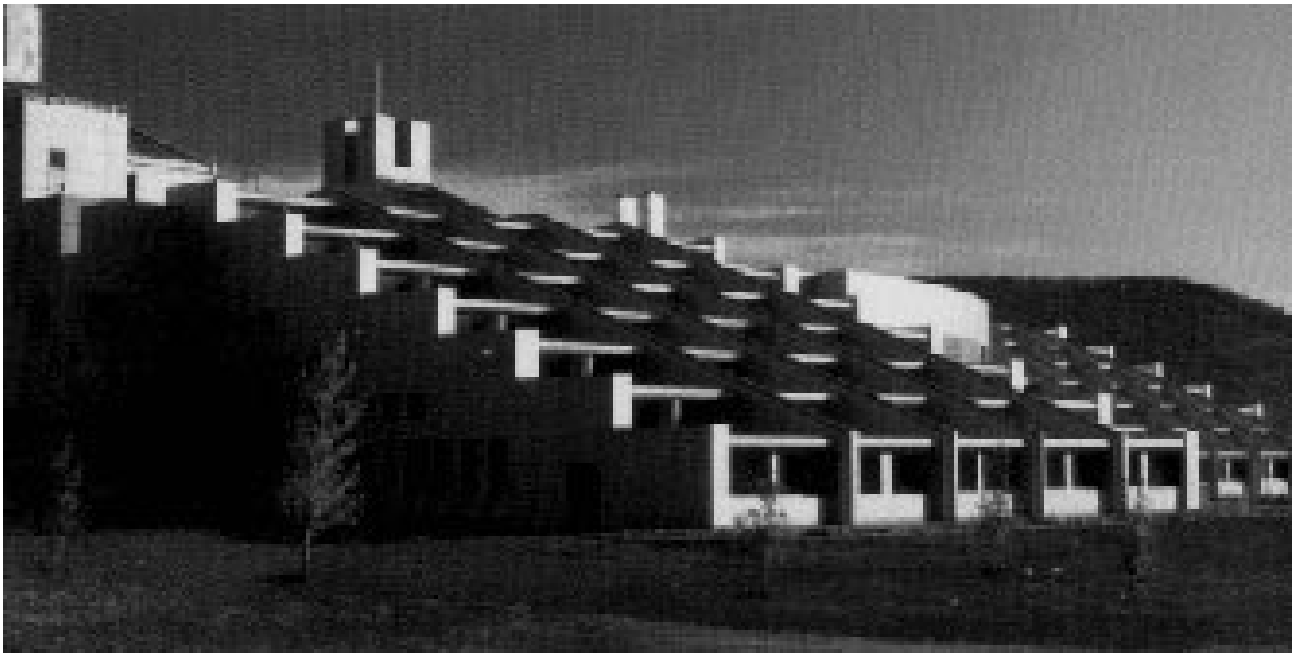
The Center decides which projects to assist based on the following criteria:

- Photovoltaics are technically, economically, and institutionally feasible.
- Financing is available for the project
- Significant near-term sales of photovoltaics could result from the project.

The Center also collects data from field experiments over a long period to provide information on the performance and reliability of components.

Contact: Hal Post at Sandia (505)844-2154 for information.

The National Renewable Energy Laboratory



The Solar Energy Research Facility at NREL

The U.S. Departments of Energy's National Renewable Energy Laboratory (NREL) is a laboratory for the research and development of renewable energy and related technologies. NREL supports the development of cost-effective renewable energy technologies for electric power generation, assists with resource planning that includes renewable energy sources, and works with industry, utilities and agencies to realize the potential of the large renewable energy market.

Each of the research divisions of NREL has programs and personnel directly supporting aspects of renewable energy technology deployment, including wind, photovoltaics, solar thermal, biomass, geothermal and energy from solid wastes. Other NREL divisions provide a variety of services including renewable resource assessment, alternative financing, design assistance, performance based contracting advice and renewable energy system installation.

Contact: Steve Rubin for general information on NREL, 303-275-4099.

Weatherization Managers Association Partnership

The Region VIII Weatherization Managers Association and the former NPS Rocky Mountain Region developed a partnership to demonstrate cost-effective weatherization techniques to the NPS. The program aims to:

- Assist NPS residents in saving a significant amount on electric bills with a 20% reduction in energy consumption.
- Facilitate knowledge sharing among various state Weatherization crews and help train NPS on weatherization technologies.
- Demonstrate how Weatherization subgrantees can leverage funds within a new housing sector.
- Use state-of-the-art weatherization techniques, including audits, tools, and materials for residential building retrofits.
- Reward top-notch Weatherization crews by having them perform retrofits in scenic National Parks.

Use of blower doors help locate air leaks.

Phase I

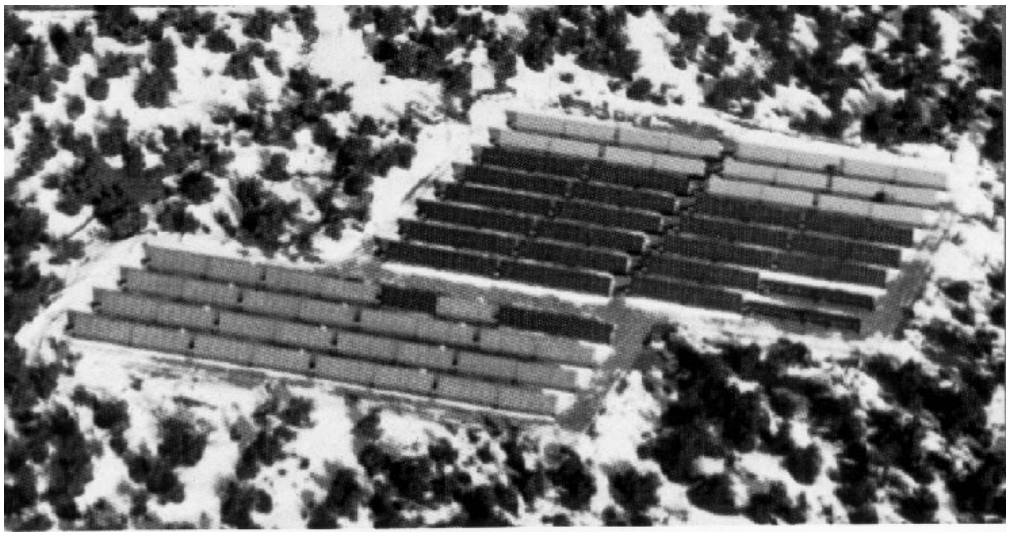
- Implement pilot projects in 3 National Parks: Grand Tetons, Mount Rushmore and Rocky Mountain National Park.
- Have Weatherization crews from all six states involved in implementation of pilot projects. (CO, MT, WY, UT, ND & SD).
- FY 1994, $110,000 ($80,000 from DOE), ($30,000 from NPS).

Phase II

- Document “before and after” energy consumption results
- Compile Park Service resident’s comments on affects of weatherization on comfort level.
- Incorporate results in NPS interpretative programs and share with other Weatherization agencies, State and Federal Parks.
- Expand to additional sites in all six states as funding becomes available.

Contact: Ben Hawkins, Denver Service Center, at (303)969-2602 for more information about the NPS - Weatherization Partnership.

NATURAL BRIDGES N.M.



PV system at Natural Bridges National Monument. Represented the largest stand-alone PV system in the U.S. at time of installation in 1980.

Solar power was first installed at Natural Bridges National Monument (NBNM) in 1980 and provided electricity for NBNM for 10 years until the battery bank failed. Lack of technical expertise and perceived funding limitations resulted in the NPS not bringing the PV system back on-line. NBNM switched to diesel-fired generators to supply electricity to Visitor Center and employee housing. A partnership between the NPS, U.S. DOE, and the Utah Department of Natural Resources provided funding, solar engineering and technical expertise necessary to restore the PV system.

Project Description

- PV system down-sized to 50 KW with diesel generator back-up.
- Restoration project added 6 KW of new solar panels, replaced battery bank with less expensive off-the-shelf batteries, up-graded wiring and simplified control panel.
- Identification and installation of energy conservation measures in NPS facilities to reduce the electricity load on the 50 KW PV system.

Results

- PV power system restored; currently provides 90% of electric power needs for NBNM Visitor Center and employee housing.
- Estimated savings of $34,000 per year in diesel fuel and maintenance costs associated with operation of diesel generators.
- NPS resource values preserved; air quality and silence, were enhanced.

Contact: Steve Chaney, Superintendent, Natural Bridges N.M., (801) 259-5174

GRAND CANYON N.P.

As part of its 75th anniversary, the Grand Canyon National Park hosted a four-day workshop in October 1994 to identify integrated design and planning solutions to promote balanced economic development, continued access to the park, and a sustainable vision for future generations. Recommendations were made for resource efficiency, transportation, waste management, agriculture, and building to address high energy bills and water consumption, deteriorating air quality and visibility. In addition, workshop participants looked to address problems attributed to out dated infrastructure, and burgeoning numbers of tourists. .

A partnership between Sandia National Labs, FEMP, and the Grand Canyon base operating program was formed to take energy and water saving measures. Photovoltaics are being considered at all remote locations.

Cottonwood PV array during installation.

Project Descriptions

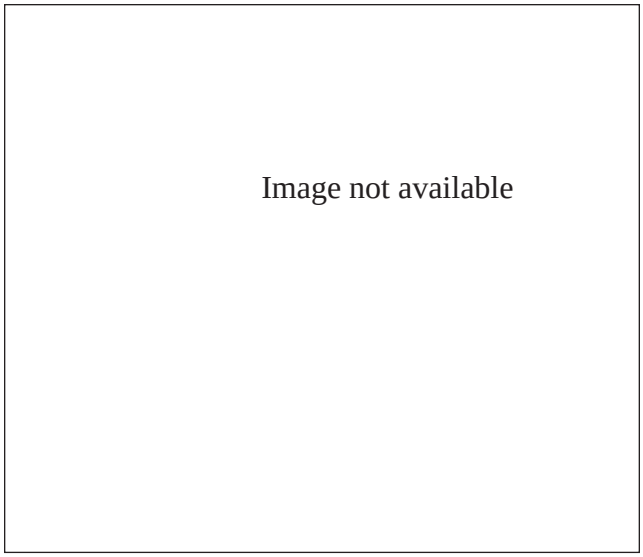
- At the remote Tuweep Ranger Station on the North Rim, a PV electric system with a 12 KW back-up generator and composting toilets, using PV powered ventilation and a roof rainwater catchment system for cleaning, were installed for $70,000.
- At Cottonwood, a remote ranger station and campground in Bright Angel Canyon, a $13,000 PV system is being installed. A 24 VDC pelton wheel with water supplied from the Transcanyon water system serves as backup.
- A proposal for FEMP money has been submitted for application of low flow plumbing fixtures and extension of reclaim water services to cut down on water use.

Results

- At Tuweep and Cottonwood a 95% reduction in nonrenewable fuels is projected with paybacks occurring in 2 years. Annual savings will be $12,500.
- Water savings will be approximately 30% with paybacks occurring in 3 years. Annual savings will be $330,000 and 17.2 million gallons.

Contact: Tim Fields, Grand Canyon N.P., (520)638-7734 x228

YELLOWSTONE N.P.



Two-cycle engines can create significant air pollution in National Parks - a challenge for Parks pursuing sustainable management principles. Snowmobiling has become so popular at Yellowstone that visitors sometimes must wait in long lines at the gas pumps.

A partnership between the Yellowstone Association, NPS and DOE to look at energy conservation and renewable energy projects in Yellowstone.

Project Description

- Received funding from the Federal Energy Efficiency Fund to modify several facilities at the park; saving more than 100 billion BTUs (26% over current consumption). Projects range from retrofits such as insulating walls and ceilings to replacing diesel generators with more efficient generators and storage systems.
- Invested in an alternative fuel truck powered by regionally grown rap seed.
- Installed over 50 applications of PV systems for communications, lighting and remote power.
- Interested in additional projects in renewable energy, energy efficiency, transportation, and solid waste management towards a "greening" of Yellowstone.

Results

- Some $600,000 in annual savings from energy conservation measures with a simple payback of 6 to 8 years.
- Reduced air emissions and improved visibility from use of PV projects, efficient generators and alternative fuel vehicles.

Contact: Tim Hudson, Yellowstone N.P., (307)344-2301

GLACIER N.P.

Just a pretty photo taken by a member of the SAVEnergy audit team at Glacier

A partnership between NPS, DRSO and the MT Dept of Natural Resources and Conservation - Energy Division, developed a proposal to the Federal Energy Efficiency Fund to make improvements to the Glacier N.P. Headquarters building. This all electric building, located in a very high degree day climate, presented a significant opportunity for energy savings mostly due to its large area of single glazed windows. Recommendations of a utility provided energy audit were revised and refined and funding sources identified to form the basis of the proposal.

Project Description

- Installation of $112,000 of improvements including better windows, lights, roof installation, and heating controls.
- Proposed leveraging of funds: DOE (53%), Utility (24%), and NPS (23%).

Results

- 40% savings on annual utility bill.
- Greatly improved occupant comfort with better individual space control.
- Energy savings of $172,000 over the 20 year life of the project.
- Reduced utility emissions.

Contact: Rudy Lobato, NPS - Denver Design Center, (303)969-2615

ARCHES N.P.

Arches National Park in Utah.

Arches N.P. spends over $22,400 per year to generate electricity with diesel-fired generators for facilitates at Devil's Garden Campground at a cost of 28¢ per KWH. Diesel generators operating 24 hours per day intrude on the silence of the Devil's Garden Campground and negatively impact air quality in the park.

A cost-shared partnership between the NPS ($40,000) and the State of Utah ($40,000) was formed to replace diesel-fired electricity generation with a PV/diesel hybrid power system. Solar engineering and energy design assistance were provided by the Utah Department of Natural Resources Building Design Assistance Center.

Project Description

- Install 4 PV/diesel hybrid systems to provide electricity for two campground host/comfort stations, a comfort station/amphitheater, and a ranger contact station. Each site has a 1.4 KW tracking array, 4 KW inverter and 40 KWH of batteries.
- Identify and install cost-effective energy conservation measures to reduce electricity use at Devil's Garden facilities.

Results

- Installation of PV/diesel hybrid power system expected to reduce diesel generator run-time to less than four hours per day.
- Estimated $12,515 in annual savings to the NPS. Operation and maintenance costs of diesel generator system reduced from $22,400 per year to $9,967.
- Air emissions from diesel generator and "noise" pollution reduced significantly.

Contact: Noel R. Poe, Superintendent, Arches National Park, (801) 259-8161

GLEN CANYON N.R.A.

Lake Powell, Glen Canyon National Recreation Area, Utah

Glen Canyon NRA spends over $100,000 to generate electricity for Dangling Rope Marina each year at an average cost of 40¢ per KWH. Diesel generators which run continuously to provide electricity to the marina, consume 65,000 gallons of fuel annually , requiring 35 forty mile barge trips up the lake each year. The generators create significant air and "noise" pollution in the NRA.

A partnership between NPS, Glen Canyon NRA and a consortium of federal, state and private energy entities was created to provide financial resources, technical engineering assistance and project management expertise necessary to install a 100 KW photovoltaic/diesel hybrid power system at Dangling Rope.

Project Description

- System design includes 75 - 100 KW PV system with 2.4 MWH battery bank and 150 KW inverter.
- Installation of $89,000 of energy efficiency improvements that reduces the electricity load by 25 percent at Dangling Rope Marina, or 213,000 KWH per year. Simple payback — about 4 years on the basis of $0.12 KWH.
- Financial participation in $1.2 million project by State of Utah ($288,000), U.S. DOE ($108,000), Sandia National Laboratory ($150,000), PacifiCorp ($150,000), NPS ($135,000), ARAMARK Leisure Services ($40,000), FEMP ($350,000).

Results

- PV/diesel hybrid system will save the NPS an estimated $2.3 million in energy costs over the 20 year life of the project.
- Operation of diesel generators will be reduced to 1,450 hours per year. Shorter run-times mean less noise and lower levels of air pollution.
- Diesel fuel consumption reduced to 22,000 gallons (11 barge trips) per year, significantly reducing the risks of a diesel fuel spill on Lake Powell.

Contact: Vic Knox, Glen Canyon NRA, (520) 608-6332.

APPENDIX - Project List

Energy Audits

- Glen Canyon NRA/Utah DNR/FEMP
  (Five Lake Powell Marinas)
- Zion N.P./Utah DNR
  (Visitor Center)
- Glacier N.P./DRSO/Montana DNRC-Energy Division
  (Visitor Center)
- Other SAVEnergy Audits planned
  (Contact Ben Hawkins, NPS - Denver)

Renewable Energy Systems

- Glen Canyon NRA/State of Utah/etc.
  (100 KW PV/Diesel hybrid system at Dangling Rope)
- Arches N.P./Utah DNR
  (4 KW PV system at Devil's Garden)
- Canyonlands N.P./Utah DNR
  (7 KW PV, Maze District ranger station and visitor center)
- Canyonlands N.P./Utah DNR/DOE
  (50 KW Natural Bridges N.M.)
- Capitol Reef N.P./Sandia Labs
  (Water Pumping PV system)
- Black Canyon of the Gunnison/Sandia
  (Visitor contact station PV system)
- Rocky Mountain N.P./Sandia/NPS
  (Bearlake PV system)

Alternative Fuels Projects

- Yellowstone N.P./Montana DNRC-Energy Division
  (Biodiesel fuel demonstration)
- Estes Park/DRSO/NPS/Larimer Cnty
  (Alternative fuel vehicles proposal)

Energy Efficient Design Assistance

- Zion N.P./Utah DNR
  (New visitor center)
- Zion N.P./NREL
  (Evaporative Cooling Tower)
- Glen Canyon NRA/Utah DNR
  (Bullfrog Marina School)
- Glen Canyon NRA/Utah DNR
  (Public Safety Bldg, Wahweep Marina)

Energy Engineering Feasibility and Economic Analysis

- Yellowstone N.P./Montana DNRC-Energy Division
  (Electric utility rate analysis)
- Glacier N.P./MT DNRC-Energy Division
  (Economic Analysis of Performance Based Contracting)
- Canyonlands N.P./Utah DNR
  (Needles District PV system)
- Glen Canyon NRA/Utah DNR
  (100 KW PV/Diesel hybrid system at Dangling Rope)
- Arches N.P./Utah DNR
  (4 KW PV system at Devil's Garden)
- Canyonlands N.P./Utah DNR
  (7 KW PV, Maze District ranger station)
- Canyonlands N.P./Utah DNR
  (50 KW PV system, Natural Bridges NM)